Incidental Catch of Halibut *(Hippoglossus stenolepis)* by Domestic Trawlers in Queen Charlotte Sound and Hecate Strait, in 1981 and 1982

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INCIDENTAL CATCH OF HALIBUT (*Hippoglossus stenolepis*) BY DOMESTIC TRAWLERS IN QUEEN CHARLOTTE SOUND AND HECATE STRAIT, IN 1981 AND 1982

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ABSTRACT

Stanley, Richard D. 1984. Incidental catch of halibut (Hippoglossus stenolepis) by domestic trawlers in Queen Charlotte Sound and Hecate Strait, in 1981 and 1982. Can. Tech. Rep. Fish. Aquat. Sci. 1318: 45 p.

The incidental catch of halibut by B.C. trawlers continues to be significant. The total annual incidental catch in Queen Charlotte Sound and Hecate Strait was estimated to be 1.6 million pounds in 1981-82. If incidental catch ratios off the west coast of Vancouver Island were comparable to those of Hecate Strait, then an estimate of the total annual catch for this period would be 2.6 million pounds. This estimate is lower than those of earlier studies but still large in comparison with the 1984 halibut quota of 9 million pounds for all of B.C. Summer and winter catch rates were approximately equal.

The majority of the observed incidental halibut from Queen Charlotte Sound and Hecate Strait were sub-legal with 94% being less than 82 cm. By weight, 78% of the incidental catch of halibut was composed of individuals less than 82 cm.

RESUME

Stanley, Richard D. 1984. Incidental catch of halibut (Hippoglossus stenolepis) by domestic trawlers in Queen Charlotte Sound and Hecate Strait, in 1981 and 1982. Can. Tech. Rep. Fish. Aquat. Sci. 1318: 45 p.

Les prises accessoires de flétan par les chalutiers de la C.-B. continuent d'être importantes. Le total des prises accessoires annuelles dans le détroit de la Reine-Charlotte et le détroit d'Hécate a été évalué à 1,6 million de livres pour 1981-1982. Si la proportion des prises accessoires au large de la côte ouest de l'île Vancouver était comparable à celle enregistrée dans le détroit d'Hecate, on pourrait alors évaluer à 2,6 millions de livres le total des prises annuelles pour cette période. Cette estimation est plus faible que celles d'étrudes antérieures, mais elle est encore considérable si on la compare au contingent de flétan, qui a été fixé en 1984 à 9 millions de lvres pour l'ensemble de la C.-B. Les taux de capture pendant l'été et l'hiver ont été à peu près égaux.

La plus grande partie des prises accessoires du flétan observées dans le détroit de la Reine-Charlotte et le détroit d'Hécate avaient une taille inférieure à la taille égale, 94 % des poissons mesurant moins de 82 cm. Selon le poids, 78 % des prises accessoires de flétan étaient constituées d'individus d'une taille inférieure à 82 cm.

INTRODUCTION

Domestic trawlers in B.C. have been prohibited since 1944 from retaining halibut caught during commercial fishing operations. This prohibition was recommended by the International Pacific Halibut Commission and is maintained because of evidence that trawlers tend to catch halibut at a sub-optimal size (Myhre 1969). As the incidental fish are often returned in an injured or at least stressed condition, the regulation implies some degree of damage to the resource. To assess this impact, numerous studies have examined the incidental catch by placing observers on commercial trawlers (Hoag 1971; Ketchen 1981). The present report is based on observations collected during 1981 and 1982 as part of a general discard study in Queen Charlotte Sound and Hecate Strait. The report includes estimates of the total incidental catch over the two-year period and summaries of the size composition.

The purpose of the report is to assist the International Pacific Halibut Commission in their assessment of the impact of discarding on the halibut stocks. The data have therefore been presented in imperial weights as used by the I.P.H.C. rather than metric. This procedure also follows Ketchen's 1981 report and provides comparability.

METHODS

The sampling procedure is described in Davenport, Selsby and Stanley (1983). Selection of trawl trips was made on the basis of area to be fished and planned target species. Hecate Strait and Queen Charlotte Sound were the primary and secondary area priorities. Within those areas, the study concentrated on the summer fisheries for Pacific cod and flatfish. The overall study was designed to examine discards of halibut, English sole (*Parophrys vetulus*), rock sole (*Lepidopsetta bilineata*), Pacific cod (*Gadus macrocephalus*), and sablefish (*Anopoploma fimbria*).

Observers estimated total halibut catch in each tow by one of three methods. Firstly, observers attempted to measure all or nearly all halibut. The measurements were converted to total weight with the following formula (I. McGregor, IPHC, pers. comm.):

$$\text{Weight (lb)} = 0.0000092043 \times \text{length (cm)}^{3.24}.$$

Of the 675 observed tows which contained halibut, all or nearly all of the halibut were measured in 236 tows (35%). When a small percentage of the halibut was not measured in a tow, the average weight of the measured halibut in that tow was used to estimate the weight of unmeasured specimens.

Secondly, when it was not possible to measure all or nearly all halibut, then observers attempted to obtain a total count. In 315 (47%) tows, all halibut were counted but none measured. I converted these counts to weights with an estimate of the average weight per halibut. The estimates were derived from the measured samples of halibut for each target-month-area category. If no data for the particular category were available, then the time frame was expanded to bi-monthly or season.

Finally, if a count was not possible owing to conflicting sampling duties for other species, observers recorded a visual estimate of total halibut weight. This third method was necessary for 124 tows (18%). For these observations, the visual estimate was converted by a "correction" formula:

$$\text{Log}_e(\text{actual}) = 0.187 + 0.968 * \log_e(\text{observed})$$

The formula was derived from 153 cases where an observer first visually estimated the weight of total halibut and then measured all the halibut for conversion to total weight. The data include observations from the three observers who collected almost all of the reference data base. The test observations were collected during both a 3-day charter to test observer accuracy and standard observer trips. The formula was derived from a non-linear parameter estimation procedure (Schnute 1982). It indicated that visual estimates under-estimate actual weight by about 10% for values just under 50 lb. The bias decreases to 0 at about 400 lb, after which visual estimates over-estimated the amount present.

I used the same definition of seasons as Hoag (1971) wherein May-August represented the "summer" season and the rest of the year represented the "winter" season.

RESULTS

DISTRIBUTION OF OBSERVATIONS

The results are based on observations collected during 33 commercial trawl trips in 1981 (17) and 1982 (16). The distribution of sampling relative to the total fishery is shown in terms of total landings by target groups in Table 1. The observations covered 2.1% of the Pacific cod and sole landings from Hecate Strait and 5.9% of these landings from Queen Charlotte Sound. Catch data were taken from the groundfish data base at the Pacific Biological Station, Nanaimo. Target species was defined as the largest non-discarded component of the observed tow or reported landing, but the actual value entered as catch equalled the sum of the catches of the non-discarded species for that tow or landing.

I grouped the various target species in two ways. To calculate current incidental catch rates, I grouped observations as shown in Table 1. These groupings reflect a combination of the sampling restraints, groupings

used in previous studies, and our general perception of the biological or depth associations within this multispecies fishery. When I have wished to compare current catches directly with historical observations I attempted to replicate the previously defined groupings.

INCIDENTAL CATCH RATE (CPUE)

Following earlier work (Hoag 1971), I estimated the incidental catch of halibut in terms of CPUE (catch of halibut/hours trawled) and catch ratio (catch of halibut/total commercial catch).

Two examples of the frequency distribution of CPUE are shown in Figure 1. The groupings were those used by Hoag (1971) except that his include west coast Vancouver Island observations and mine probably include proportionately more Dover sole and turbot tows. Unlike the observations from the 1960s, the frequency distribution for all target species groupings took a negative binomial form rather than a Poisson. There were proportionately fewer tows with no halibut in 1981 and 1982. However, there were also fewer tows of large amounts of halibut in 1981 and 1982. Hoag (1971) reports that 54 of 3031 tows (1.8%) exceeded 1000 lb/hr. In 1981 and 1982, only one of 776 tows (0.1%) showed that high a catch rate.

Bimonthly overall CPUE is shown in Table 2 for comparison with Figure 3 of Hoag (1971). Recent observations do not indicate significantly higher catch rates in summer months, unlike earlier observations. This is also indicated in Table 3 where I have compared seasonal CPUE by the two target groupings used by Hoag. Flatfish observations exclude 5D Dover sole data because this fishery did not exist in the earlier period.

The CPUE of halibut by season and area is shown in Table 4 for 1981 and 1982 combined.

Mean CPUE (Table 4) and its variance were calculated after weighting by total effort for each category:

$$\bar{Y} = \frac{1}{N} \sum_{i=1}^{2} \sum_{j=1}^{2} \sum_{k=1}^{6} n_{ijk} \bar{y}_{ijk}$$

$$\text{Var.}(\bar{Y}) = \frac{1}{N^2} \sum_{i=1}^{2} \sum_{j=1}^{2} \sum_{k=1}^{6} N^2_{ijk} (\text{Var. } \bar{y}_{ijk})$$

$\bar{Y}$ = weighted mean CPUE of halibut for all categories
N = total fishing effort
i = area (a=2)

j = season (b=2)
k = target group (c=6)
$\bar{y}_{ijk}$ = mean CPUE of halibut for area, season and target stratum
n_{ijk} = total fishing effort for area, season and target stratum

Sampling effort was directed away from the Pacific ocean perch fishery, so discard estimates for these fisheries had to be obtained from additional sources. For the Moresby Gully/Hecate Strait POP fishery, I used data from the 43 hauls conducted during a POP biomass survey in 1981 (Carter et al. 1982) plus 8 hauls observed in the present study. No winter observations were available so mean summer CPUE was assumed representative of winter fishing.

The Queen Charlotte Sound estimates for the POP fishery were derived from 4 hauls observed in the present study and 4 observed in 1978 (Ketchen 1981). Again, no winter observations were available so the summer estimate was used.

The total Queen Charlotte Sound and Hecate Strait incidental catch of halibut was calculated as described by Hoag (1971) except that the actual total fleet effort was categorized by target group. It was not necessary to use sampled fishing effort to calculate total fishing effort by target group. Table 5 shows total fishing effort by target group.

The total estimate for 1981 and 1982, both areas combined, was 2.50 million pounds with a 95% confidence interval of 0.9 million pounds (Table 6). Mean annual effort for the two areas for 1962-69 was 26,123 hours as compared with 19,104 hours during 1981-82.

INCIDENTAL CATCH RATIO

The catch ratio of halibut was used as a second estimator of incidental catch by Hoag and as the only method by Ketchen (1981). Total catch was calculated by multiplying each catch ratio (Table 7) by the total landings of the fleet associated with that category and summing the products.

$$C = \sum_{i=1}^{2} \sum_{j=1}^{2} \sum_{k=1}^{6} R_{ijk} L_{ijk}$$

C = total incidental catch from 1981-82
i = area (a=2)
j = season (b=2)
k = target group (c=6)
R_{ijk} = estimated catch ratio for area, season and target stratum
L_{ijk} = total landings by fleet for area, season and target stratum

This differs from Hoag (1971) who equated total landings of a target category with total landings of the target species.

Saila (1983) describes how to compute confidence limits about a ratio estimator. His procedure was not attempted partly because of the limited sample size. More importantly, there were some significant sources of bias which preclude attaching much significance to the confidence limits. These are discussed later. Information on the variance of CPUE was included for comparability with the work of Hoag (1971).

The catch ratios and estimated incidental catches of halibut by target group are shown in Tables 7 and 8. Table 9 shows a comparison of total CPUE of commercial catch between "observed" and total fleet activities. The total estimate for 1981-82 combined, based on the catch ratio, was 3.3 million pounds.

LENGTH FREQUENCY OBSERVATIONS

Length frequency data is summarized in Tables 10, 11, and 12 by area, season and target category. Figures 2-11 show length observations by target group.

DISCUSSION

The reason for the discrepancy between the CPUE and catch ratio estimates is revealed in Table 9. In the "others" category, the observed trips under-represented overall fleet catch rates. This category tended in observer trips to be a miscellaneous grouping of relatively unsuccessful tows. The target catch was often a small quantity of skate, rex sole or lingcod. Within fleet calculations, the "others" category tended more often to include directed fishing for pollock, dogfish and lingcod; tows which were not well represented in our sampling. The halibut estimate derived from the catch ratio method is therefore used in subsequent calculations. The CPUE based estimate is retained for comparison with previous work and to demonstrate the difficulty of attempting to stratify the limited data base.

Table 13 summarizes other estimates of incidental halibut catch. Comparing Hoag's conclusion to the present results, we see a difference in halibut catch of about 27%. Most of this decline can be attributed to Queen Charlotte Sound where total yearly effort averaged 8058 hrs in 1981-82 as compared with 16,412 hrs during the 1960s. Hecate Strait totals are quite similar. Effort averaged 10,067 hours during the 1960s and 11,046 hours in 1981-82. Vessels tend to be larger and better equipped now than two decades

ago, so should be more efficient at catching halibut. The unchanging catch total would indicate that halibut are not as abundant by weight or trawlers tend to fish less in areas of high concentration. As mentioned earlier, the incidence of high catch rates of halibut (>1000 lb/hr) is much lower now.

The low abundance of Pacific cod in 1981-82 reduced effort on this target species. Since this fishery is associated with a fairly high catch of halibut (Table 7), this also may have reduced current estimates of the incidental catch.

The 1978 and 1980 data show opposing results. The 1978 results might be suspect owing to the small number of tows (n=72, summer:Hecate Strait). The 1980 observation might be inflated because all the observations were made in July and August and assumed to be representative of May and June. Table 2 of the present report indicated a much higher catch rate in the latter part of the summer.

It is somwehat fruitless to compare current discard ratios with previous work owing to the changes in the fisheries. As a relative measure of halibut catch it would be better to examine incidental catches within a specific locality/date stratum but at this level of detail it would be hard to find sufficient observations. Some results are shown in Table 14 to illustrate the variation seen over time in specific discard rates.

A coastwide estimate of halibut discards for B.C. requires some means of assessing discards for grounds off Vancouver Island (Areas 3B, 3C, and 3D) and the Queen Charlotte Islands (Area 5E). Hoag's (1971) report remains the only study of the Vancouver Island grounds. He reported catch ratios slightly higher than those of Hecate Strait while CPUE estimates were slightly lower. If one assumes that current Hecate Strait catch ratio estimates would be reasonably appropriate for Vancouver Island grounds, then the estimated annual halibut catch based on total landings for these grounds would have been 0.94 million pounds. Details by target group are provided in Table 15. Approximately two-thirds of the estimate is contributed by the "others" category, for which dogfish and lingcod were the primary target species.

No observer data is available for the rockfish grounds off the west coast of the Queen Charlotte Islands so I have used the haul data from rockfish surveys (Nagtegaal and Farlinger 1980) conducted in 1979 which focussed on the important commercial grounds. In 73 tows, approximately 348 lbs of halibut were caught in conjunction with 101,800 lbs of commercial fish for a ratio of 0.003. The total commercial bottom trawl catch of almost entirely rockfish averaged 2.59 million lbs in 1981-82 which would indicate an annual incidental halibut catch of 0.004 million pounds. The area estimates are summarized in Table 16. It indicates a coastwide catch of 2.6 million lbs.

The major source of error in this estimate is clearly the Vancouver Island contribution. It not only is based on Hecate Strait ratios and thus doesn't reflect variation in abundance or distribution between the two areas, but two-thirds of the 0.936 millions pounds estimated for this area is contributed by the "others" category. As discussed earlier, this category represents a miscellaneous grouping in the observer data of often relatively

unsuccessful tows. In the Vancouver Island case, it represents very productive fishing for dogfish and lingcod.

A second source of error lies in the possibility that a fish may be caught more than once (Hoag 1971). This implies that estimates are inflated but without information on the incidence of recapture it is impossible to calculate the magnitude of this bias.

I assumed that summer catch rates were equal to winter rates in the two Pacific Ocean perch fisheries. This may be inaccurate but these fisheries contribute little towards the total discard figures.

Finally, the analysis ignores the limited bottom trawl fishery inside Georgia Strait. Bottom trawling in this area produced approximately 2600 tonnes per year in 1981 and 1982 but there are no data on the incidence of halibut. The absence of commercial halibut fishing from this area would indicate that halibut abundance is quite low.

All the length data combined indicated that 94% of the discarded halibut were sub-legal (<82 cm). No consistent or major differences were observed between summer and winter. Mean size tended to be smaller in the Hecate Strait fisheries. It was also smaller in association with the shallower water fisheries for Pacific cod, English and rock soles. Both these observations were noted by Hoag (1971).

Unlike the 1960s, the incidental catch appeared to be composed of much smaller fish. Hoag reported that for flatfish and other groundfish, 22% were less than 65 cm. In 1981 and 1982, the estimate was 34%. Similarly, Ketchen (1981) reported that for 1980, 88% of July-August caught halibut in Hecate Strait were below the current sub-legal limit of 82 cm. In 1981 and 1982, the summer figure was 95%.

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Table 1. Comparison of landings observed with total fishery landings by area, season and target group, 1981 and 1982 combined.

	Total landings (lb)	Observed landings (lb)	% observed
QUEEN CHARLOTTE SOUND			
Summer			
Pacific cod	2,128,348	35,485	1.67
Rockfish	2,232,868	99,301	0.44
Pacific ocean perch	10,039,307	2,843	0.03
Turbot and Dover sole	1,347,473	25,536	1.90
Rock and English sole	879,315	31,862	3.62
Others	3,178,505	52,815	1.66
Total	19,805,816	247,842	1.25
Winter			
Pacific cod	940,608	63,825	6.79
Rockfish	4,066,749	69,151	1.70
Pacific ocean perch	3,283,021	0	0.00
Turbot and Dover sole	270,324	19,513	7.22
Rock and English sole	288,771	5,308	1.84
Others	1,800,496	6,087	0.34
Total	10,649,969	163,884	1.54

Table 1 (cont'd)

	Total landings (lb)	Observed landings (lb)	% observed
HECATE STRAIT			
Summer			
Pacific cod	7,213,374	141,883	2.00
Rockfish	1,233,051	10,529	0.85
Pacific ocean perch	6,721,324	6,820	0.10
Turbot and dover sole	3,283,471	51,376	1.56
Rock and English sole	2,550,861	67,120	2.63
Others	1,343,973	8,958	0.67
Total	22,346,054	286,686	1.28
Winter			
Pacific cod	6,369,229	136,963	2.15
Rockfish	1,750,517	13,713	0.78
Pacific ocean perch	1,338,395	82	0.00
Turbot and dover sole	1,047,500	105,756	10.10
Rock and English sole	2,928,036	31,483	1.08
Others	2,921,480	53,463	1.83
Totals	16,355,157	341,460	2.09
	69,156,996	1,039,872	1.50

Table 2. Bimonthly CPUE (lb/hr) by area for non-rockfish target species.

	Q.C. Sound		Hecate Strait	
	No.	$\bar{X}$	No.	$\bar{X}$
January-February	0	-	19	101.9
March-April	33	71.2	126	47.4
May-June	84	65.0	194	51.8
July-August	23	93.5	59	147.7
September-October	17	76.5	100	130.1
November-December	3	37.5	11	34.8

Table 3. Summer/winter mean CPUE (lb/hr) by area and target group.

		Q.C. Sound		Hecate Strait	
		62-69	81-82	62-69	81-82
Flatfish[a]	CPUE (n)	84/13 (253/9)	105/96 (36/8)	165/63 (392/176)	72/78 (104/61)
Other groundfish	CPUE (n)	221/35 (437/50)	48/78 (123/78)	249/35 (250/108)	70/90 (145/175)

[a]Omitted Hecate Strait Dover sole fishery.

Table 4. Number of hauls, mean CPUE (lb/hr) by area, season and target group, 1981 and 1982 combined.

		Q. C. Sound		Hecate Strait	
		Summer	Winter	Summer	Winter
Pacific cod	No.	22	34	119	120
	$\bar{x}$	26.6	56.5	73.3	101.6
	$S_{\bar{x}}$	7.25	24.32	7.10	16.28
Rockfish	No.	52	33	9	13
	$\bar{x}$	40.6	94.7	70.4	52.2
	$S_{\bar{x}}$	16.96	50.83	29.26	16.76
Pacific ocean	No.	8[a]	-[b]	51[c]	-[b]
perch	$\bar{x}$	2.0	2.0	8.0	8.0
	$S_{\bar{x}}$	3.30	3.30	3.00	3.00
Turbot and	No.	13	3	39	45
Dover sole	$\bar{x}$	2.9	157.1	79.5	50.7
	$S_{\bar{x}}$	1.20	77.48	27.27	7.71
English and	No.	23	5	75	43
rock sole	$\bar{x}$	162.5	59.9	69.4	79.6
	$S_{\bar{x}}$	46.79	23.43	11.39	11.58
Others	No.	49	11	20	48
	$\bar{x}$	66.4	97.3	85.6	71.0
	$S_{\bar{x}}$	13.21	35.55	36.32	11.07

[a]Results of 4 tows from 1978 observations and 4 tows from 1981-82 observations.

[b]Used summer estimate.

[c]Results from 43 tows of 1981 biomass survey (Carter et al. 1982) and 8 tows from 1981-82 observations.

Table 5. Total bottom trawl effort in hours by target group and season in Queen Charlotte Sound and Hecate Strait, 1981 and 1982 combined.

	Q. C. Sound		Hecate Strait	
Target group	Summer	Winter	Summer	Winter
Pacific cod	1,596	642	4,324	4,375
Rockfish	1,533	2,326	738	703
Pacific ocean perch	2,656	687	1,704	643
Turbot and Dover sole	649	67	1,862	614
English and rock sole	1,009	346	1,995	2,906
Others	3,071	1,534	597	1,631
Total	10,514	5,602	11,220	10,872

Table 6. Estimated seasonal catch (lb) of incidental halibut by target species based on CPUE (1981 and 1982 combined).

	Q. C. Sound		Hecate Strait		
	Summer	Winter	Summer	Winter	Total
Pacific cod	42,454	36,273	316,949	444,500	840,176
Rockfish	62,240	220,272	51,955	36,697	371,164
Pacific ocean perch	5,312	1,374	13,632	5,144	25,462
Turbot and Dover sole	1,882	10,526	148,029	31,130	191,567
English and rock sole	163,962	20,725	138,453	231,318	554,458
Others	203,914	149,258	51,103	115,801	520,076
Totals	479,764	438,428	720,121	864,590	2,502,903

Table 7. Catch ratio of halibut to total commercial catch by area, season and target.

Target group	Q. C. Sound		Hecate Strait	
	Summer	Winter	Summer	Winter
Pacific cod	0.022	0.037	0.061	0.082
Rockfish	0.030	0.034	0.061	0.047
Pacific ocean perch	0.001	0.001	0.004	0.004
Turbot and Dover sole	0.001	0.021	0.056	0.025
English and rock sole	0.195	0.059	0.074	0.095
Others	0.090	0.137	0.191	0.060

Table 8. Estimated seasonal catch (lb) of incidental halibut based on the halibut discard ratio (1981 and 1982).

	Q. C. Sound		Hecate Strait		
	Summer	Winter	Summer	Winter	Total
Pacific cod	46,824	34,802	440,016	522,277	1,043,919
Rockfish	66,986	138,269	75,216	82,274	362,745
Pacific ocean perch	10,039	3,283	26,885	5,354	45,561
Turbot and Dover sole	1,347	5,677	183,874	26,188	217,086
English and rock sole	171,466	17,037	188,764	278,163	655,430
Others	286,065	246,668	256,699	175,289	964,721
Totals	582,727	445,736	1,171,454	1,089,545	3,289,462

Table 9. Comparison of CPUE (lb/hr) between total fleet and observed trips (1981 and 1982).

	Q. C. Sound				Hecate Strait			
	Summer		Winter		Summer		Winter	
	Fleet	Observed	Fleet	Observed	Fleet	Observed	Fleet	Observed
Pacific cod	1,334	1,149	1,465	1,859	1,668	1,204	1,456	1,164
Rockfish	1,457	1,252	1,748	2,138	1,670	1,378	2,490	1,217
Pacific ocean perch	3,780	574	4,779	-	3,944	1,106	2,081	99
Turbot and Dover sole	2,076	2,282	4,035	6,862	1,763	1,548	1,706	1,968
English and rock sole	871	926	835	993	1,279	827	1,008	851
Others	1,035	764	1,174	781	2,251	560	1,791	1,262

Table 10. Halibut length frequency observations from Queen Charlotte Sound by season and target, 1981-1982 combined.

Target season	Pacific cod		Rockfish		English and rock sole	Others	
	Summer	Winter	Summer	Winter	Summer	Summer	Winter
n	38	321	81	36	121	238	44
30	-	-	-	-	-	-	-
31	-	-	-	-	2	-	-
32	-	-	-	-	0	-	-
33	-	-	-	-	5	1	-
34	-	-	-	-	2	0	-
35	-	-	-	-	3	0	-
36	-	-	-	-	1	2	-
37	-	-	-	-	1	0	-
38	-	-	-	-	1	0	-
39	-	-	-	-	2	2	-
40	-	-	-	-	2	2	-
41	-	-	-	-	1	3	-
42	-	-	-	-	1	1	-
43	-	-	-	-	2	1	-
44	-	1	-	-	0	5	-
45	-	0	-	-	1	9	-
46	-	0	-	-	3	5	-
47	-	3	-	-	3	4	-
48	-	0	-	-	1	3	-
49	-	9	-	2	1	4	-
50	-	7	1	0	1	6	0
51	-	8	0	0	1	3	0
52	-	5	0	1	2	9	0
53	-	14	1	0	1	7	0
54	1	5	0	1	3	2	0
55	1	10	1	0	4	4	4
56	1	15	0	1	0	2	1
57	0	12	2	2	3	2	2
58	1	13	0	1	3	4	2
59	0	15	1	2	1	5	3
60	1	18	1	2	6	5	1
61	0	13	0	3	2	3	4
62	4	16	4	1	4	4	2
63	4	18	2	2	6	6	4
64	1	13	0	0	0	9	2
65	2	11	2	4	5	4	3
66	0	10	1	2	2	12	0
67	0	10	5	2	2	5	2
68	2	12	3	1	4	9	2
69	1	5	6	0	2	6	2

Table 10 (cont'd)

Target season	Pacific cod		Rockfish		English and rock sole	Others	
	Summer	Winter	Summer	Winter	Summer	Summer	Winter
70	3	7	5	1	5	8	2
71	2	8	4	3	1	9	0
72	1	6	4	0	3	12	1
73	1	7	5	0	4	6	1
74	0	6	3	0	1	4	1
75	1	4	1	1	4	3	0
76	3	8	4	1	3	6	1
77	1	4	3	0	3	5	0
78	2	3	1	0	1	6	2
79	0	6	2	0	0	2	0
80	1	2	4	0	2	3	1
81	1	1	0	1	2	4	0
82	0	2	2	0	1	1	0
83	0	2	0	1	0	2	1
84	0	2	0	0	1	2	-
85	1	1	1	0	0	1	-
86	0	0	1	0	2	5	-
87	0	1	1	0	0	1	-
88	0	1	0	0	0	0	-
89	0	2	1	0	2	3	-
90	0	1	0	0	0	3	-
91	0	0	0	0	0	1	-
92	0	0	1	0	0	0	-
93	0	1	0	0	0	0	-
94	0	0	0	0	1	0	-
95	0	0	0	0	0	0	-
96	0	0	2	0	0	0	-
97	0	0	1	0	0	1	-
98	2	0	0	0	0	0	-
99	-	0	0	0	0	0	-
100	-	1	0	0	1	0	-
101	-	0	0	0	-	0	-
102	-	0	2	0	-	0	-
103	-	0	0	0	-	1	-
104	-	0	0	0	-	-	-
105	-	0	0	0	-	-	-
106	-	0	1	1	-	-	-
107	-	2	1	-	-	-	-
108	-	-	0	-	-	-	-
109	-	-	0	-	-	-	-
110	-	-	0	-	-	-	-
128	-	-	1	-	-	-	-

Table 11. Halibut length frequency observations from Hecate Strait by season and target, 1981 and 1982 combined.

Target	Pacific cod		Rockfish		Pacific ocean perch	English & Rock sole		Turbot & Dover sole		Others	
season	Sum.	Win.	Sum.	Win.	Sum.	Sum.	Win.	Sum.	Win.	Sum.	Win.
n	1589	421	141	130	9	648	409	548	264	235	230
20	-	1	-	-	-	-	-	-	-	-	-
23	-	0	-	-	-	1	-	-	-	-	-
30	1	0	-	-	-	0	-	-	3	-	4
31	1	0	-	-	-	1	-	-	0	-	0
32	0	1	-	-	-	0	-	-	0	-	2
33	1	0	-	-	-	0	-	-	2	-	3
34	0	0	-	-	-	1	-	-	0	-	1
35	1	0	-	-	-	0	-	-	0	-	4
36	4	1	-	1	-	3	-	-	7	-	3
37	4	0	-	0	-	0	-	-	1	-	0
38	7	2	-	0	-	8	1	-	4	-	2
39	9	4	-	0	-	13	0	-	2	-	1
40	18	11	-	2	-	19	0	-	10	-	3
41	18	1	1	1	-	16	0	-	5	-	0
42	25	3	2	2	-	24	1	-	4	-	3
43	19	2	0	0	-	29	2	-	2	-	8
44	29	6	3	0	-	14	6	1	5	-	6
45	30	12	2	1	-	25	5	1	2	1	7
46	34	11	0	4	-	33	6	1	10	0	9
47	38	26	5	6	1	22	10	1	6	1	7
48	42	12	2	4	0	25	15	6	5	0	4
49	53	4	4	3	0	20	11	8	5	9	3
50	46	12	4	2	0	19	15	16	9	8	13
51	55	9	6	1	0	17	13	5	8	3	1
52	50	18	6	5	1	19	18	10	3	5	6
53	47	15	3	1	0	20	16	18	6	6	9
54	54	18	4	2	0	8	23	16	6	14	4
55	73	13	4	4	0	18	21	24	2	13	8
56	73	18	2	5	0	14	28	16	3	10	4
57	67	26	3	4	1	8	25	23	1	11	10
58	55	13	4	6	0	15	21	24	4	15	6
59	52	7	4	4	0	13	22	16	2	13	2
60	62	13	5	6	0	17	22	17	9	9	11
61	50	14	4	5	0	12	22	18	7	8	4
62	50	16	2	5	0	12	11	21	8	7	3
63	46	11	3	5	1	6	13	11	4	8	4
64	37	18	5	2	0	9	6	16	4	6	9
65	47	9	3	0	0	13	14	15	2	10	5
66	37	6	1	11	0	9	11	22	10	9	6
67	36	8	7	6	1	17	6	22	1	8	3
68	43	7	4	2	0	6	5	21	3	5	5
69	29	7	6	3	0	9	4	15	2	7	2

Table 11 (cont'd)

Target season	Pacific cod		Rockfish		Pacific ocean perch	English & Rock sole		Turbot & Dover sole		Others	
	Sum.	Win.	Sum.	Win.	Sum.	Sum.	Win.	Sum.	Win.	Sum.	Win.
70	36	6	6	9	1	11	9	14	4	5	3
71	23	5	2	4	0	5	2	21	4	4	0
72	24	3	2	1	1	5	2	20	5	2	2
73	17	2	0	3	0	10	2	12	1	6	0
74	27	3	3	1	0	6	2	17	4	2	3
75	24	7	4	0	0	7	4	11	6	5	3
76	18	8	2	0	0	7	3	11	7	4	2
77	7	2	2	0	0	3	0	15	1	2	2
78	7	1	1	0	0	5	1	13	2	1	4
79	5	5	1	0	0	2	1	6	0	0	0
80	7	2	2	3	0	7	0	5	10	3	8
81	6	0	1	1	0	3	0	9	2	4	0
82	6	1	1	1	0	1	0	2	4	0	1
83	5	1	1	1	0	0	0	5	1	2	2
84	6	3	2	0	0	6	0	5	4	5	0
85	2	1	1	0	0	7	1	1	0	1	1
86	3	1	1	0	1	3	2	6	1	1	1
87	2	1	0	0	0	4	0	4	0	0	1
88	4	0	3	1	0	1	1	1	3	0	0
89	2	0	0	0	0	1	0	0	1	0	1
90	1	0	1	2	0	3	1	3	4	0	1
91	2	1	1	-	0	2	0	1	4	0	0
92	0	0	0	-	1	5	1	0	1	0	0
93	0	0	0	-	-	2	0	0	1	0	0
94	1	0	0	-	-	0	1	0	1	0	1
95	3	0	1	-	-	1	0	1	2	1	0
96	3	3	0	-	-	0	0	0	2	0	1
97	0	0	1	-	-	1	0	0	0	0	0
98	0	0	0	-	-	2	0	0	3	1	2
99	1	1	0	-	-	1	0	0	1	0	0
100	0	0	0	-	-	1	1	1	4	0	1
101	0	0	0	-	-	1	1	-	0	0	0
102	0	0	0	-	-	3	0	-	0	0	0
103	0	0	0	-	-	1	0	-	0	0	0
104	0	0	0	-	-	2	1	-	2	0	1
105	0	0	0	-	-	1	-	-	0	0	0
106	0	0	0	-	-	1	-	-	1	0	0
107	1	2	0	-	-	0	-	-	1	0	0
108	0	0	0	-	-	0	-	-	1	0	0
109	0	0	0	-	-	0	-	-	0	0	0
110	1	0	1	-	-	0	-	-	3	0	0
111	0	0	0	-	-	0	-	-	1	0	0
112	0	0	0	-	-	1	-	-	0	0	0
113	0	0	0	-	-	1	-	-	0	0	0

Table 11 (cont'd)

Target season	Pacific cod		Rockfish		Pacific ocean perch	English & Rock sole		Turbot & Dover sole		Others	
	Sum.	Win.	Sum.	Win.	Sum.	Sum.	Win	Sum.	Win.	Sum.	Win.
114	1	0	1	-	-	0	-	-	0	0	0
115	1	0	0	-	-	1	-	-	0	0	0
116	-	0	0	-	-	0	-	-	0	0	1
117	-	0	0	-	-	0	-	-	0	0	0
118	-	0	0	-	-	0	-	-	1	0	0
119	-	0	0	-	-	0	-	-	0	0	0
120	-	0	0	-	-	2	-	-	2	0	1
121	-	0	0	-	-	0	-	-	1	0	-
122	-	0	0	-	-	0	-	-	0	0	-
123	-	0	0	-	-	0	-	-	1	0	-
124	-	0	0	-	-	2	-	-	-	0	-
125	-	0	0	-	-	0	-	-	-	0	-
126	-	0	0	-	-	-	-	-	-	1	-
127	-	1	0	-	-	-	-	-	-	0	-
132	-	0	1	-	-	-	-	-	-	0	-
138	-	0	-	-	-	-	-	-	-	1	-
145	0	0	-	-	-	-	-	-	-	1	-
146	-	1	-	-	-	-	-	-	-	0	-
154	-	0	-	-	-	-	-	--	-	1	-
165	-	1	-	-	-	-	-	-	-	0	-
178	-	-	-	-	-	-	-	-	-	1	-

Table 12. Mean halibut length and percent by number less than 65 cm, and 82 cm by area, season and target species, 1981 and 1982 combined.

		Queen Charlotte Sound		Hecate Strait		
		Summer	Winter	Summer	Winter	Total
Pacific cod	No.	38	321	1589	421	2369
	x	69.9	63.7	58.6	58.5	59.4
	S_x	10.14	9.96	10.98	13.99	11.64
	%<65 cm	36.8	60.7	72.4	76.5	71.0
	%<82 cm	92.1	95.0	97.2	95.7	96.5
Rockfish	No.	81	36	141	130	388
	x	74.4	65.0	64.3	60.7	65.3
	S_x	12.99	10.53	14.85	10.74	13.70
	%<65 cm	16.0	50.0	55.3	65.4	49.0
	%<82 cm	81.5	94.4	88.7	96.2	90.2
Pacific ocean perch	No.	-	-	9	-	9
	x	-	-	67.4	-	67.4
	S_x	-	-	14.71	-	14.71
	%<65 cm	-	-	44.4	-	44.4
	%<82 cm	-	-	77.8	-	77.8
Turbot & Dover sole	No.	-	-	548	264	812
	x	-	-	65.1	64.3	64.9
	S_x	-	-	9.97	20.51	14.3
	%<65 cm	-	-	49.1	56.4	51.5
	%<82 cm	-	-	94.5	80.7	90.0
English & rock sole	No.	121	-	648	409	1178
	x	60.2	-	58.4	58.2	58.5
	S_x	15.65	-	17.99	9.02	15.21
	%<65 cm	57.0	-	71.1	81.4	73.3
	%<82 cm	93.4	-	90.4	97.6	93.2
Others	No.	238	44	235	230	747
	x	64.0	64.7	62.6	58.0	61.7
	S_x	13.47	7.23	9.59	15.72	13.12
	%<65 cm	47.5	56.8	62.6	72.2	62.5
	%<82 cm	91.2	97.7	95.3	93.0	95.6
Total	No.	478	401	3170	1454	5503
	x	65.3	63.9	60.2	59.6	60.8
	S_x	14.53	9.77	12.97	14.50	13.44
	%<65 cm	43.7	59.4	66.6	72.3	65.6
	%<82 cm	90.2	95.3	94.8	93.1	94.0

Table 13. A summary of historical estimates of the annual incidental halibut catch by area based on discard ratios (millions of pounds).

	Queen Charlotte Sound		Hecate Strait		
	Summer	Winter	Summer	Winter	Total
1962-1969[a]	1.117	0.132	0.653	0.350	2.252
1978[b]	0.331	0.019	0.191	0.111	0.652
1980[c]	-	-	1.200	-	-
1981-1982	0.291	0.223	0.586	0.545	1.645

[a]Hoag (1971).

[b]Ketchen (1979).

[c]Ketchen (1980).

Table 14. Summary of historical estimates of halibut ratios by target species.

		Queen Charlotte Sound		Hecate Strait	
		Summer	Winter	Summer	Winter
Flatfish	1962-69	0.063	0.019	0.060	0.064
	1978	0.018	-	0.027	0.013
	1980	-	-	0.106[b]	-
	1981-82[a]	0.195[a]	0.059[a]	0.074	0.095
Pacific cod	1980	-	-	0.086	-
	1981-82	0.022	0.037	0.061	0.082

[a]Rock sole and English sole.

[b]Rock sole and English sole (July and August).

Table 15. Estimated seasonal catch (lb) of halibut by target species off the west coast of Vancouver Island (1981 and 1982 combined).

	Total landings	Halibut ratio in Hecate Strait	Total halibut catch
Summer			
Pacific cod	2,520,885	0.061	153,774
Rockfish	920,450	0.061	56,147
Pacific ocean perch	856,756	0.004	3,427
Turbot and Dover sole	625,891	0.056	35,050
Rock and English sole	367,034	0.074	27,161
Others	5,616,851	0.191	1,072,819
Total	10,907,867		1,348,378
Winter			
Pacific cod	2,261,427	0.082	185,437
Rockfish	935,181	0.047	43,954
Pacific ocean perch	1,921,779	0.004	7,687
Turbot and Dover sole	670,314	0.025	16,758
Rock and English sole	111,397	0.095	10,583
Others	4,316,184	0.060	258,971
Total	10,216,282		523,390
Grand total			1,871,768

Table 16. Estimated total annual catch of incidental halibut by domestic trawlers in B.C. in millions of pounds.

	Summer	Winter	Total
W. coast Vancouver Island[a] (Areas 3B, 3C, and 3D)	0.674	0.262	0.936
Queen Charlotte Sound (Areas 5A and 5B)	0.291	0.223	0.514
Hecate Strait (Areas 5C and 5D)	0.586	0.545	1.131
W. coast Queen Charlotte Islands[b] (Areas 5E)	-	-	0.004
			2.585

[a]Halibut catch ratio from Hoag (1971) and total trawl landings from PBS, Nanaimo data base for years 1981 and 1982.

[b]Halibut catch ratio from Nagtegaal and Farlinger (1980) and total trawl landings from PBS, Nanaimo data base for years 1981 and 1982.

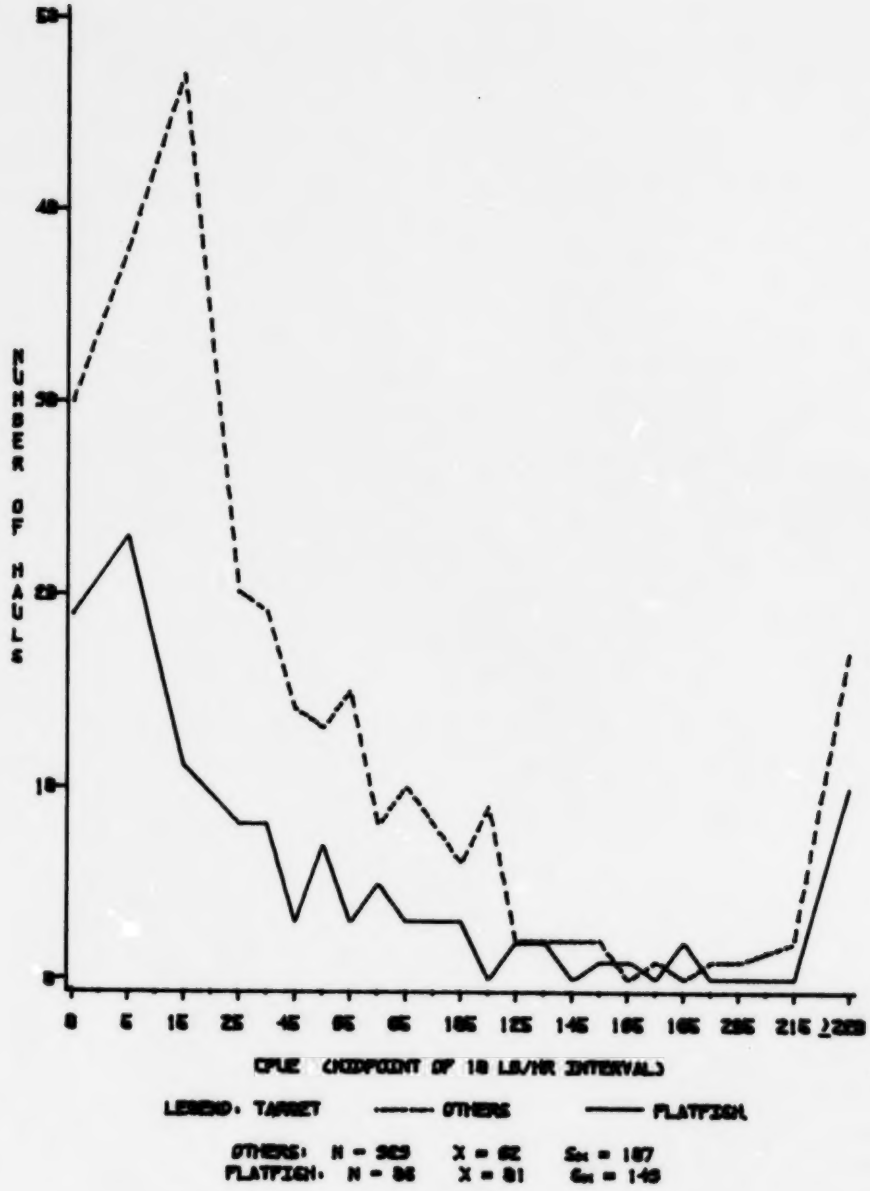
NUMBER OF HAULS
0
10
20
40
50
0 5 15 25 45 65 85 105 125 145 165 185 205 215 ≥220
CPUE (MIDPOINT OF 10 LB/HR INTERVAL)
LEGEND: TARGET ------ OTHERS —— FLATFISH
OTHERS: N = 303 X = 62 Sx = 107
FLATFISH: N = 86 X = 81 Sx = 149

FIGURE 1. FREQUENCY DISTRIBUTION OF HALIBUT CPUE (LB/HR) BY TARGET GROUP DURING THE SUMMER (MAY-AUG).

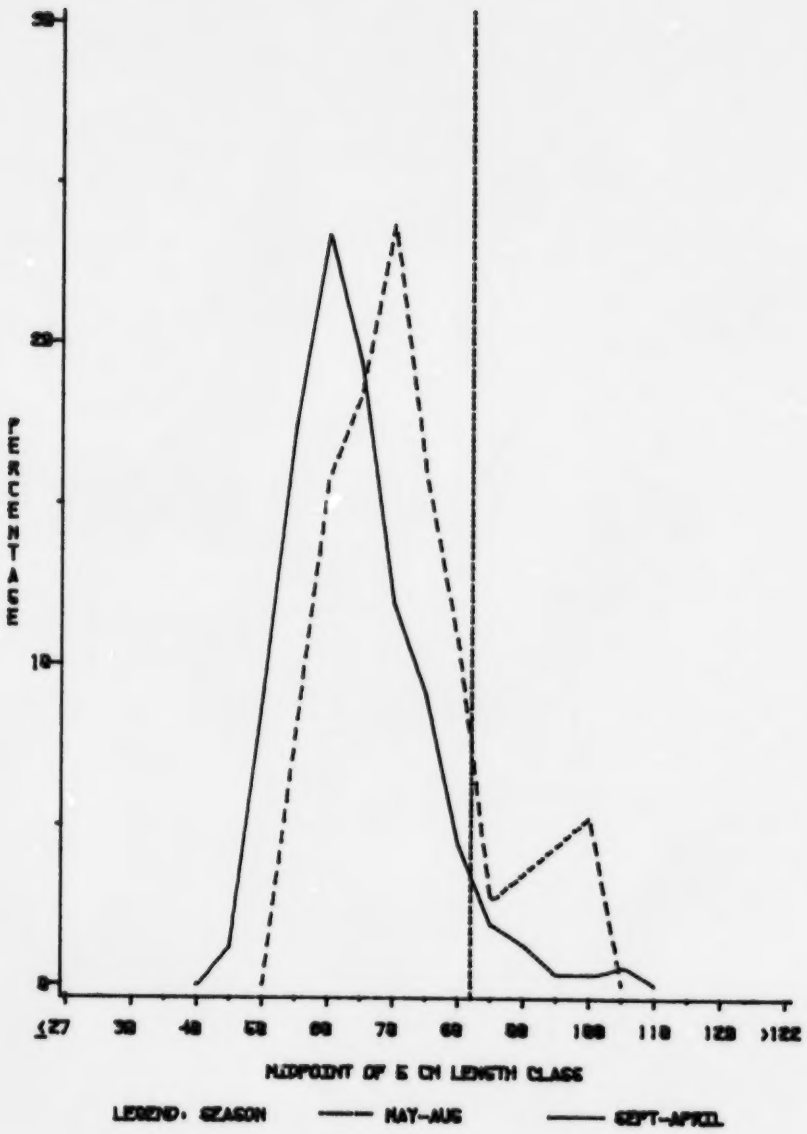

FIGURE 2. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN QUEEN CHARLOTTE SOUND DURING PACIFIC COD FISHERY

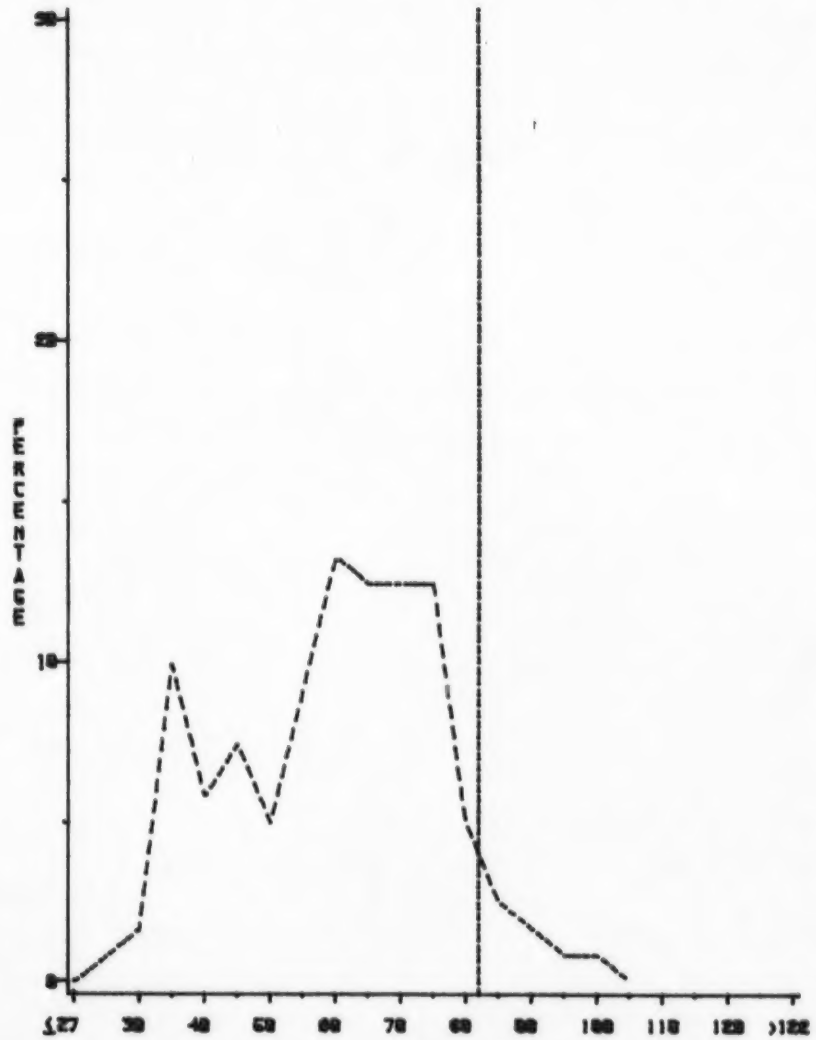

FIGURE 5. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN G. C. SOUND DURING ENGLISH AND ROCK SOLE FISHERY

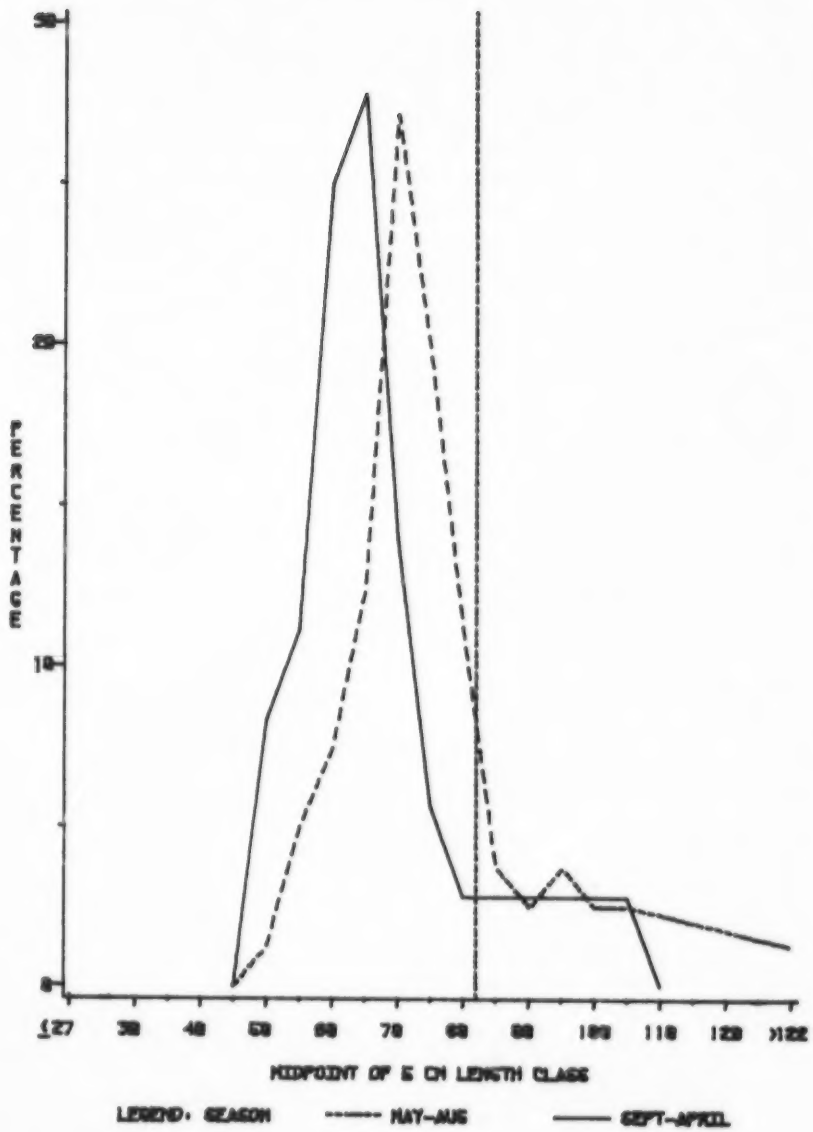

FIGURE 4. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN QUEEN CHARLOTTE SOUND DURING ROCKFISH FISHERY

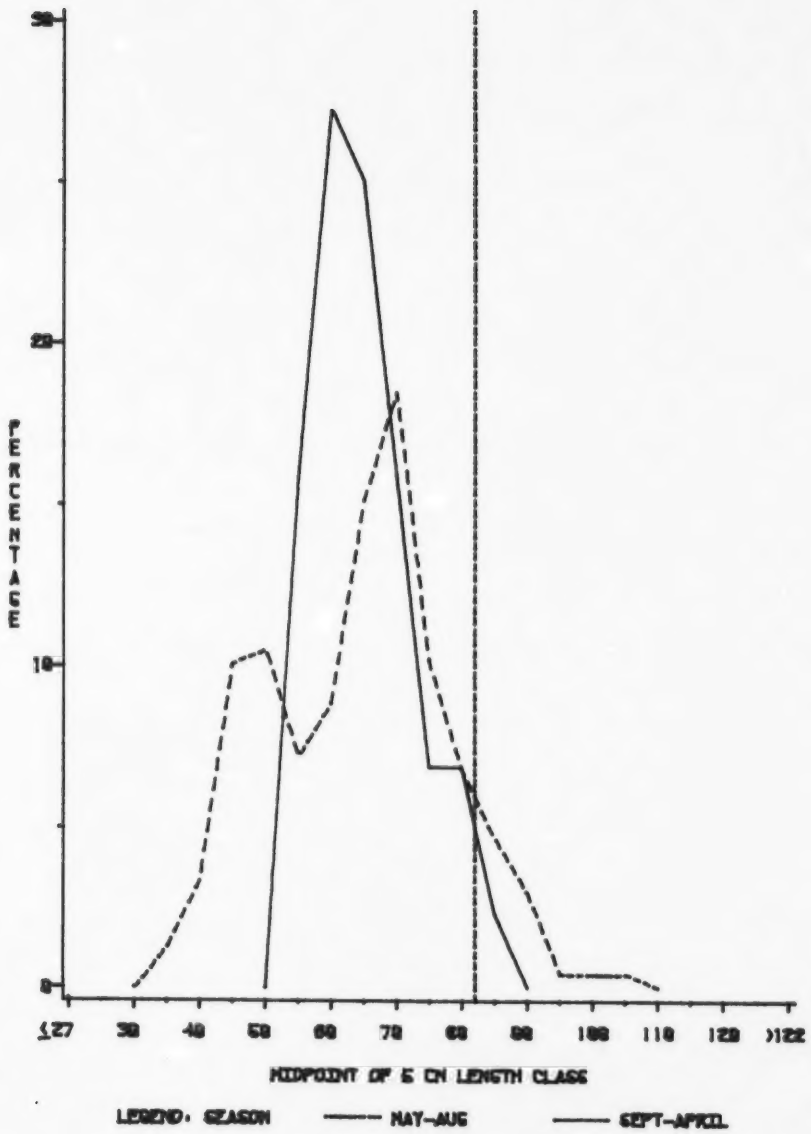

FIGURE 5. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN QUEEN CHARLOTTE SOUND DURING FISHERY FOR OTHER SPECIES

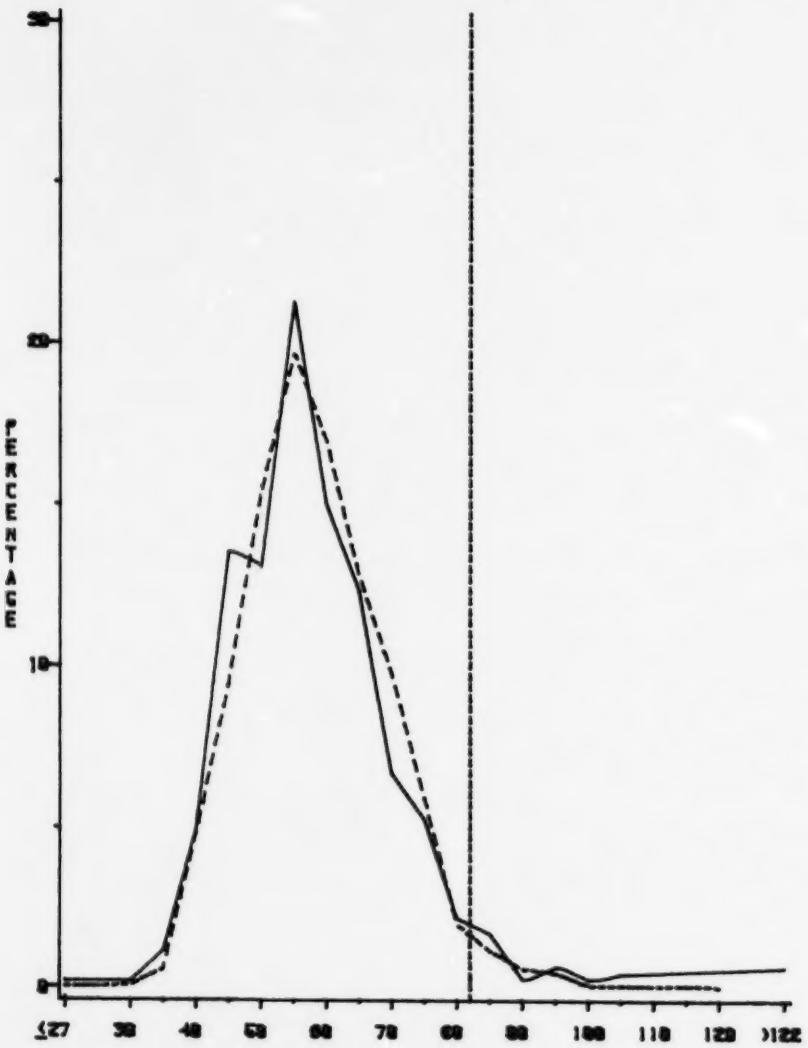

FIGURE 6. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN HECATE STRAIT DURING PACIFIC COD FISHERY

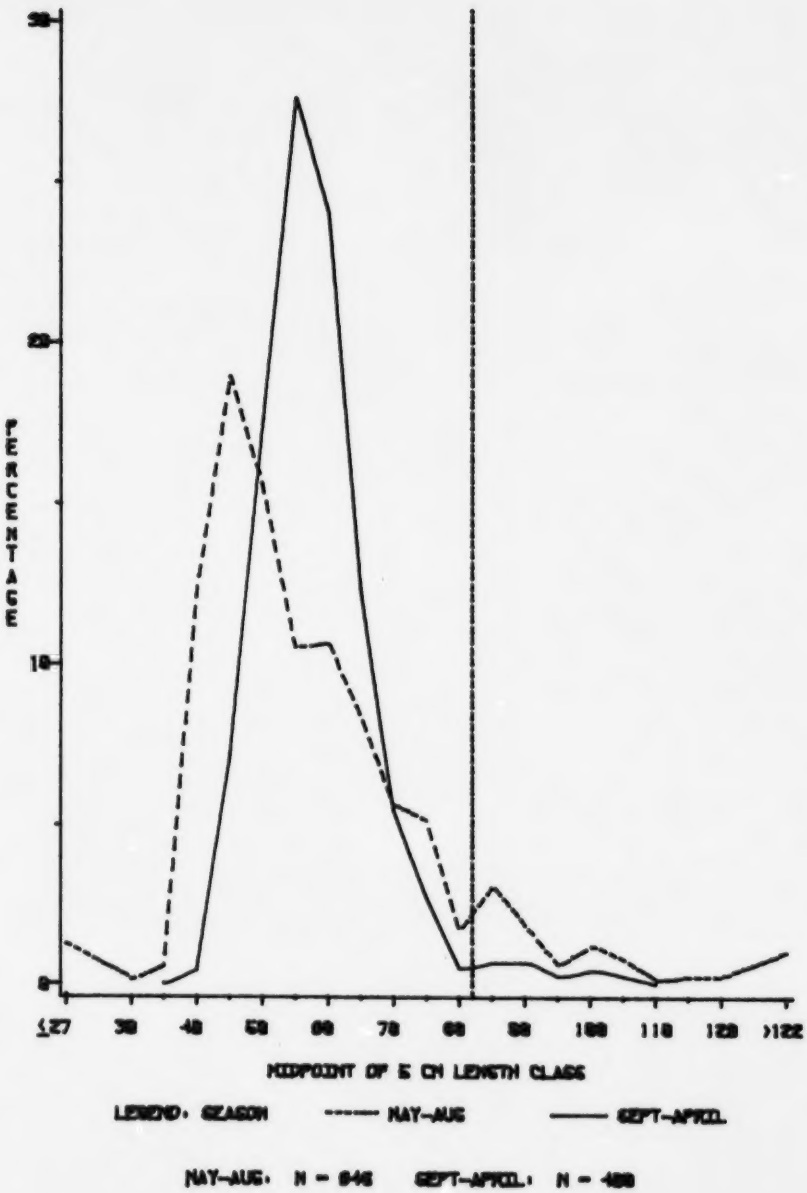

FIGURE 7. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN HECATE STRAIT DURING ENGLISH AND ROCK SOLE FISHERY

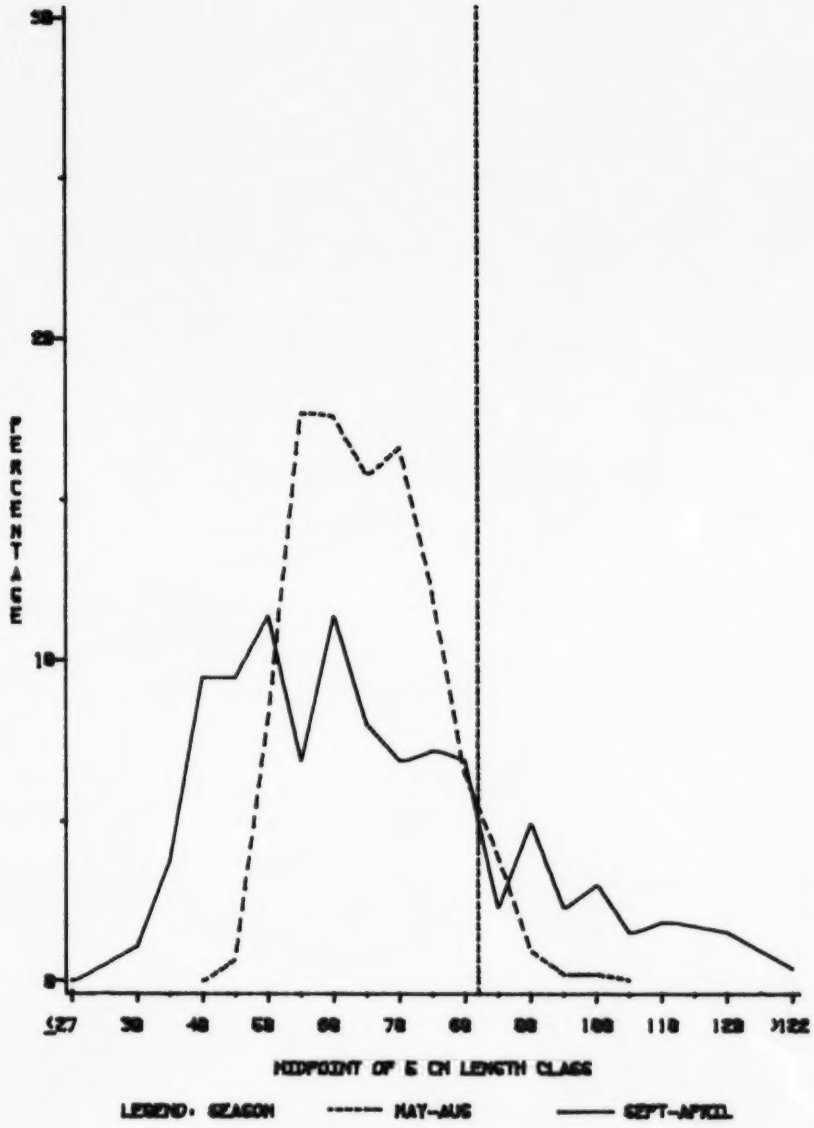

FIGURE 6. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN HECATE STRAIT DURING TURBOT AND DOVER SOLE FISHERY

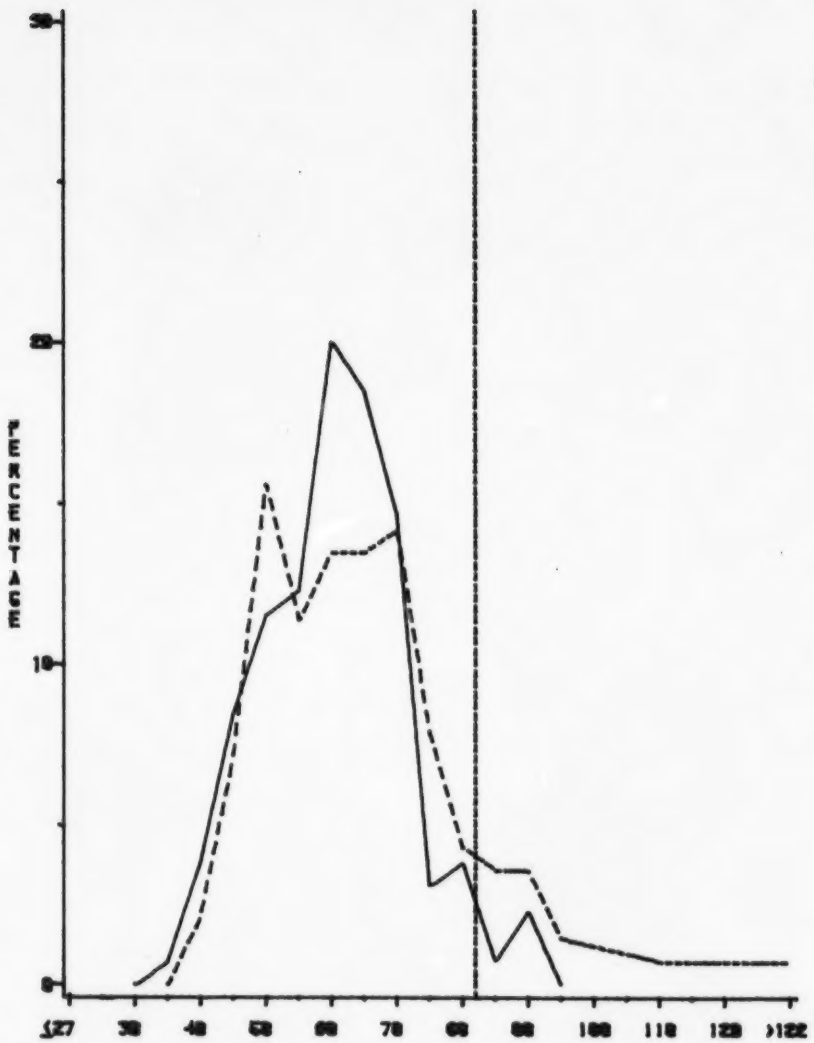

FIGURE 9. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN HECATE STRAIT DURING ROCKFISH FISHERY

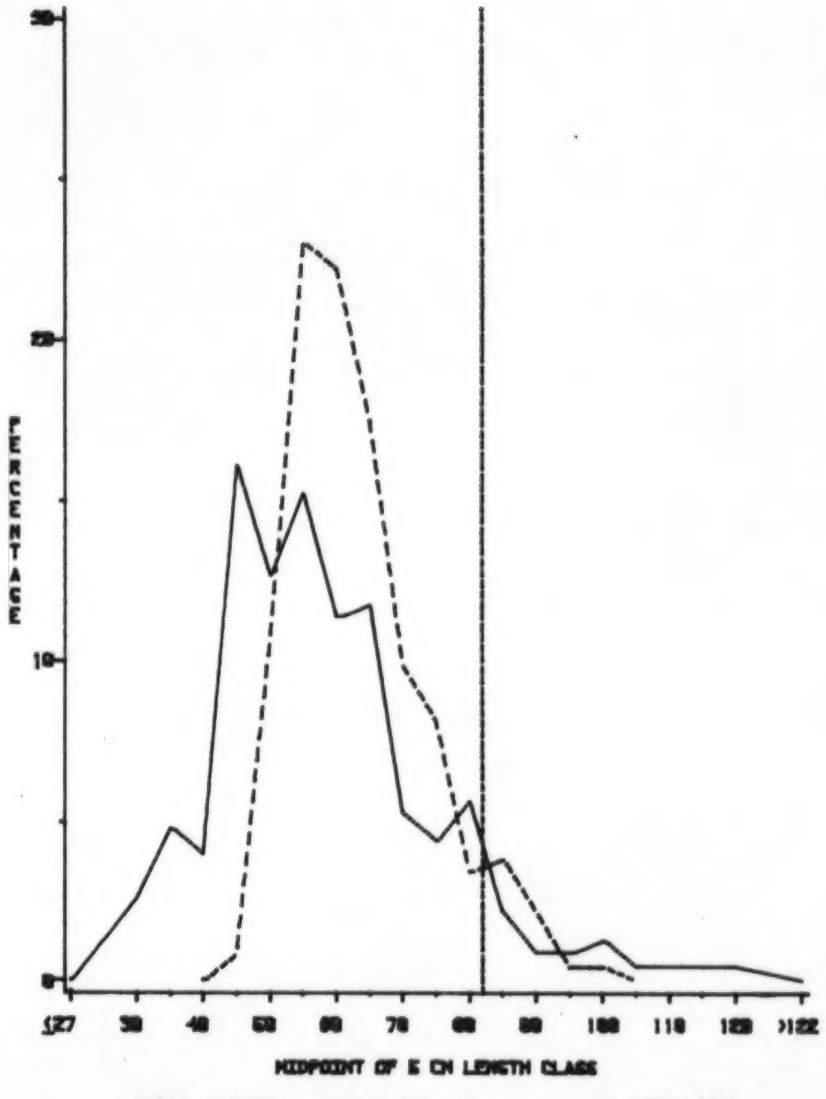

FIGURE 18. LENGTH DISTRIBUTION OF INCIDENTAL HALIBUT CAUGHT IN HECATE STRAIT DURING FISHERY FOR OTHER SPECIES